

Claims

1. A solid-state-laser pumping module comprising:

a pumping medium member including a plate-shaped solid
5 state laser medium that provides a gain generated by absorption
of pumping light to laser light to amplify the laser light, a
reflecting member disposed on a surface of said solid state
laser medium which is opposite to a laser light incidence
surface of said solid state laser medium, for reflecting the
10 laser light which is incident upon said solid state laser medium
via said light incidence surface and which propagates through
said solid state laser medium, and a cooling member for removing
heat which is transferred thereto, via said reflecting member,
from said solid state laser medium,

15 the laser light incidence surface of said solid state
laser medium having a size of a in a direction perpendicular
to a plane defined by both an optical axis of said laser light
and a normal to the laser light incidence surface of said solid
state laser medium, and a size of b in a longitudinal direction
20 perpendicular to said direction and said normal, the sizes
having a relationship given by $b=a/\cos\theta$, where θ is an incidence
angle at which said laser light is incident upon the laser light
incidence surface.

25 2. The solid-state-laser pumping module according to
Claim 1, characterized in that the laser light is linearly
polarized light which is polarized in either the direction
perpendicular to the plane defined by both the optical axis of
said laser light and the normal to the laser light incidence
30 surface of said solid state laser medium, or a direction in said

plane.

3. The solid-state-laser pumping module according to Claim 1, characterized in that the incidence angle θ of the laser
5 light is 45 degrees or more.

4. The solid-state-laser pumping module according to Claim 1, characterized in that the incidence angle θ of the laser
light is a Brewster angle peculiar to the solid state laser
10 medium.

5. The solid-state-laser pumping module according to Claim 1, characterized in comprising a slab waveguide member having an incidence end surface via which the pumping light
15 generated by a pumping light source is incident thereupon, and an emergence end surface having a smaller area than the incidence end surface, said emergence end surface being bonded to a pumping light incidence surface of the solid state laser medium, for introducing the pumping light from said pumping
20 light source into said solid state laser medium via said pumping light incidence surface.

6. The solid-state-laser pumping module according to Claim 1, characterized in that the reflecting member and the
25 cooling member are bonded to each other using a bonding agent having a higher degree of softness than the solid state laser medium, for bonding the reflecting member and the cooling member to each other while covering projections and depressions which exist on their bonding surfaces which are to be bonded to each
30 other.

7. The solid-state-laser pumping module according to Claim 1, characterized in that the reflecting member and the cooling member are bonded to each other using an optical bonding agent having a smaller refractive index than the solid state laser medium.

8. The solid-state-laser pumping module according to Claim 1, characterized in that the laser light incidence surface of the solid state laser medium of the pumping medium member has at least m regions (m is a positive integer) which are running along said longitudinal direction, each of said m regions having a size of a in the direction perpendicular to a plane defined by both the optical axis of said laser light and the normal to the laser light incidence surface of said solid state laser medium, and a size of b in the longitudinal direction perpendicular to said direction and said normal, the sizes having a relationship given by $b=a/\cos\theta$, where θ is the incidence angle at which said laser light is incident upon the laser light incidence surface, and characterized in that said pumping module comprises a reflecting mirror for successively reflecting the laser light reflected by the reflecting member toward said solid state laser medium so that the laser light is incident upon said solid state laser medium m times at the incidence angle θ .

9. The solid-state-laser pumping module according to Claim 8, characterized in comprising a polarization rotating member disposed in a laser light path between the reflecting member and the reflecting mirror, for rotating polarization of

the laser light by 90 degrees.

10. The solid-state-laser pumping module according to Claim 8, characterized in that the reflecting mirror rotates
5 the polarization of the laser light reflected from the reflecting member by 90 degrees.

11. The solid-state-laser pumping module according to Claim 8, characterized in that the pumping medium member
10 includes solid state laser media arranged at locations thereof upon which the laser light which is successively reflected by the reflecting mirror is successively incident, and a slab waveguide member for connecting said solid state laser media to one another, and for making the pumping light pass through
15 said solid state laser media.

12. The solid-state-laser pumping module according to Claim 11, characterized in that said slab waveguide member covers all surfaces of each of the solid state laser media except
20 the laser light incidence surface of each of the solid state laser media and a bonding surface of each of the solid state laser media which is bonded to the reflecting member, and said slab waveguide member has a cross-sectional area which decreases with distance from the incidence end surface of said
25 slab waveguide member via which the pumping light is incident upon said slab waveguide member such that the introduced pumping light is condensed to one of the solid state laser media which is arranged at a position distant from said incidence end surface.

13. A solid-state-laser pumping module comprising:

a plurality of pumping medium members each including a plate-shaped solid state laser medium that provides a gain generated by absorption of pumping light to laser light to amplify the laser light, a reflecting member disposed on a surface of said solid state laser medium which is opposite to a laser light incidence surface of said solid state laser medium, for reflecting the laser light which is incident upon said solid state laser medium via said light incidence surface and which propagates through said solid state laser medium, and a cooling member for removing heat which is transferred thereto, via said reflecting member, from said solid state laser medium, the laser light incidence surface of said solid state laser medium having a size of a in a direction perpendicular to a plane defined by both an optical axis of said laser light and a normal to the laser light incidence surface of said solid state laser medium, and a size of b in a longitudinal direction perpendicular to said direction and said normal, the sizes having a relationship given by $b=a/\cos\theta$, where θ is an incidence angle at which said laser light is incident upon the laser light incidence surface, and said plurality of pumping medium members being arranged so that each of said plurality of pumping medium members outputs the laser light which is amplified by said solid state laser medium thereof and is reflected by said reflecting member thereof as output light, and so that the output light from one of said plurality of pumping medium members arranged at a preceding stage is incident upon another one of said plurality of pumping medium members arranged at a next stage and said laser light is successively amplified by said plurality of pumping medium members.

14. The solid-state-laser pumping module according to Claim 13, characterized in comprising a polarization rotating member disposed in a laser light path between the one of said plurality of pumping medium members arranged at the preceding stage and the other one of said plurality of pumping medium members arranged at the next stage, for rotating polarization of the laser light by 90 degrees.

15. The solid-state-laser pumping module according to Claim 13, characterized that the other one of said plurality of pumping medium members arranged at the next stage is arranged so that a direction perpendicular to a plane defined by both an optical axis of the laser light incident upon the one of said plurality of pumping medium members arranged at the preceding stage, and a normal to the laser light incidence surface of the solid state laser medium of the one of said plurality of pumping medium members matches with a direction perpendicular to a plane defined by both an optical axis of the laser light incident upon the other one of said plurality of pumping medium members, and a normal to the laser light incidence surface of the solid state laser medium of the other one of said plurality of pumping medium members.

16. A laser oscillator comprising:

a pumping medium member including a plurality of plate-shaped solid state laser media which provide their respective gains generated by absorption of pumping light to plural beams of laser light to amplify the plural beams of laser light, a reflecting member disposed on surfaces of said

plurality of said solid state laser media which are opposite to laser light incidence surfaces of said plurality of solid state laser media, for reflecting the plural beams of laser light which are incident upon said plurality of solid state laser media via said light incidence surfaces and which propagate through said plurality of solid state laser media, respectively, and a cooling member for removing heat which is transferred thereto, via said reflecting member, from said plurality of solid state laser media, said plurality of solid state laser media being arranged at locations of said pumping medium member upon which the plural beams of laser light are incident, respectively, and said plurality of solid state laser media being connected to one another via a slab waveguide member which makes the pumping light propagate through said plurality of solid state laser media; and

an optical system for repeatedly making the plural beams of laser light be incident upon said plurality of solid state laser media of said pumping medium member, respectively, and making the plural beams of laser light reflected from said reflecting member be re-incident upon said plurality of solid state laser media of said pumping medium member, respectively, so as to cause laser oscillations.

17. The laser oscillator according to Claim 16, characterized in that the plural beams of laser light which oscillate in said plurality of solid state laser media respectively are made to be in phase with one another.

18. The laser oscillator according to Claim 16, characterized in that said slab waveguide member covers all

surfaces of each of the plurality of solid state laser media except the laser light incidence surface of each of the plurality of solid state laser media and a bonding surface of each of the plurality of solid state laser media which is bonded
5 to the reflecting member, and said slab waveguide member has a cross-sectional area which decreases with distance from an incidence end surface of said slab waveguide member via which the pumping light is incident upon said slab waveguide member such that the introduced pumping light is condensed to one of
10 the plurality of solid state laser media which is arranged at a position distant from said incidence end surface.

19. The laser oscillator according to Claim 16, characterized in that the reflecting member and the cooling
15 member are bonded to each other using a bonding agent having a higher degree of softness than the plurality of solid state laser media, for bonding the reflecting member and the cooling member to each other while covering projections and depressions which exist on their bonding surfaces which are to be bonded
20 to each other.

20. The laser oscillator according to Claim 16, characterized in that the reflecting member and the cooling
member are bonded to each other using an optical bonding agent
25 having a smaller refractive index than the plurality of solid state laser media.